

Impact of Varietal Improvement in West African Crop Ecologies



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This ex-post impact study, recently submitted to the CGIAR Impact Assessment and Evaluation Group, found that productivity improvement from genetic enhancement and pure-line selection contributed approximately US\$374 million to the US\$1.85 billion rice-production economy in the seven most important rice-producing nations of West Africa in 1998. Overall, genetic enhancement and transfer has increased net revenues by US\$100 per hectare, but the gain is highest in the irrigated and rainfed lowland ecologies.

investment in varietal improvement, 197 varieties have been released over the past 20 years, which have generated sizable gains in rice productivity.

Using conservative adoption estimates, and relying upon historical data on national costs of rice imports, the study determined that varietal improvement contributes, on the average, US\$374 million per year to the regional economy and could be as high as US\$848 million (Fig. 1). Over 39% of this gain is attributable to CGIAR germplasm-improvement programs either as direct varietal products or as parents in national breeding

Background

The history of varietal improvement in West Africa may be characterized as disjunct, with many actors and overlapping activities often simultaneously pursuing similar objectives until the late 1980s. In the 1990s, varietal improvement activities were centralized at WARDA and new collaborative mechanisms have developed in order to facilitate varietal improvement and to target the more difficult rice-production ecologies of the rainfed lowlands and uplands. Despite this past, case-study evidence in several countries indicates that the returns to investment in rice research have always exceeded 20% annually and a revision of these studies would likely indicate higher returns.

Findings

This study has indicated that limited resources are invested in varietal improvement. Each year, approximately 36 scientist-years in the national programs and 10 additional scientist-years at WARDA are allocated to rice varietal improvement. Financial investment does not exceed US\$3.2 million annually. Despite such limited

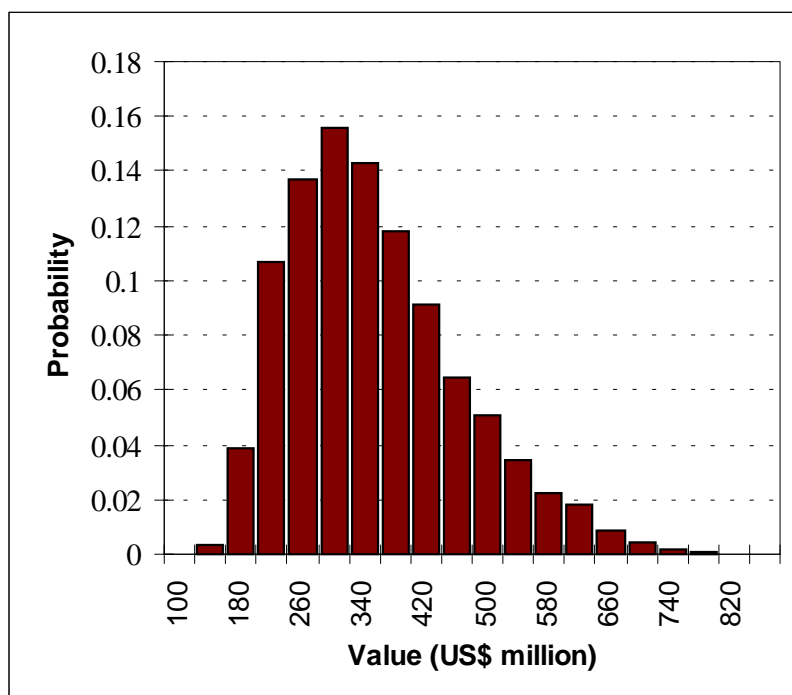


Figure 1. Probability Distribution of the Regional Financial Impact of Varietal Improvement and Transfer

programs. In addition to the role of CGIAR programs in varietal development, this study has identified a second important role of CGIAR Centers in coordinating germplasm exchange, including regional and exotic traditional varieties as well as varieties developed by Asian national

programs. Across the region, few varieties have generated panterritorial impact, underscoring the importance of highly variable production conditions even within favorable ecologies.

Varietal gains have largely occurred in the more favorable ecologies: the irrigated and rainfed lowlands. According to national partners, adoption

that transfer of varieties into a highly heterogeneous production ecology is possible. In the next five years, 37 new varieties for the uplands are expected to be released including low-management *O. sativa* cultivars and several of WARDA's 'new rices for Africa'—stable progeny of interspecific crosses between Asian (*Oryza sativa*) and African

Distributional Impact of Varietal Improvement (US\$ thousand)

Total Gains	Rainfed Upland	Rainfed Lowland	Irrigated Lowland	Mangrove Swamp	Deep-water Floating	Total	Gain/ha (US\$)
Nigeria	24,041	145,168	39,251			208,461	117
Guinea	7,600	19,001		3,605		30,206	68
Côte d'Ivoire	13,658	7,014	22,474			43,147	58
Sierra Leone	9,738	7,482	818	1,578		19,616	68
Mali	24	299	27,861		8,677	36,862	122
Ghana		29,659	1,498			31,157	325
Senegal		304	4,516			4,819	69
Total	55,062	208,927	96,419	5,182	8,677	374,267	100
Gain/ha (US\$)	32	163	232	69	32	100	

rates are close to 100% in the irrigated ecologies and about 62% in the rainfed lowlands. Per-hectare gains in output are approximately US\$232 and US\$163, respectively. While the production of improved materials for the mangrove ecology has been impressive, per-hectare gains here have been about US\$69, largely due to the high productivity of the ecology even when cultivated to traditional varieties. Almost all impact in the floating ecology is due to the transfer of Asian deep-water materials.

By contrast, gains in the uplands have been much more modest, especially outside of Nigeria. While adoption rates in Nigeria are high, the yield gains per hectare have been slight. In other upland rice producing countries, adoption rates of improved materials do not exceed 20% when introduced traditional varieties are excluded. In the traditional upland rice growing belt of West Africa of Côte d'Ivoire, Liberia, Sierra Leone and Guinea, almost all popular released varieties are pure-line traditional varieties: LAC 23, Moroberekan, Iguape Cateto, Ngovie, Ngiema Yakei and OS6. Nonetheless, productivity has only increased by US\$32 per hectare within that ecology.

The widespread coverage of introduced varieties (including traditional varieties) indicates

(*O. glaberrima*) rices. Many of these varieties have shown productivity gains of 24% over local varieties in widespread farmer-controlled evaluations. The financial value of such a gain in just Guinea, Côte d'Ivoire and Sierra Leone, assuming a 10% adoption rate, would amount to nearly US\$8 million per year—this rises to nearly US\$20 million at 25% adoption rates.

In addition to the upland ecology, 31 new varieties are destined for release in the rainfed lowlands. Many of these varieties have been developed to target stress-prone areas for which introduced Asian germplasm did not generate productivity gains. These two ecologies represent strategically important areas for future research and extension activities as they cover more than 70% of the total rice area cultivated annually.

For more information

Dalton, T.J. and R.G. Guei, in press. Ecological Diversity and Rice Varietal Improvement in West Africa. In: Evenson, R.E. and D. Gollin (ed.) *Crop Variety Improvement and Its Effect on Productivity: The Impact of International Agricultural Research*. CABI, Wallingford, UK.